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PHILOSOPHICAL
TRANSACTIONS

- I. *Extract of a Letter from Dr. John Ingenhoufz, F. R. S. to Sir John Pringle, Bart. P. R. S. containing some Experiments on the Torpedo, made at Leghorn, January 1, 1773 (after having been informed of those by Mr. Wallh). Dated Saltzburg, March 27, 1773.*

Redde, Nov. 10,
1774. AS I could get no torpedos alive to my lodgings at Leghorn, I hired a fishing vessel, called a *tartana*, with eighteen men in her, and went out twenty miles to sea, where the bottom is muddy, and where those fish are chiefly to be found. We caught five; of which, four were about a foot in length, and the other of a smaller size. Before the nets were taken up, I charged a coated jar by a glass tube, and gave a shock to some of the sailors; who all told me, they felt

the same sensation as when they touched the torpedo. Those people acquainted me, that this animal has but very little force in winter, and cannot live a long time out of the water. As soon as the whole quantity of fish caught was hauled up upon deck, I put the torpedos immediately into a tub, filled with sea water, together with two or three other fishes, which I found not at all hurt by their company. I took one of the torpedos in my hand, so that my thumbs pressed gently the upper side of those two soft bodies at the side of the head, called (perhaps very improperly) *musculi falcati* by REDI and LORENZINI, whilst my forefingers pressed the opposite side. About one or two minutes after, I felt a sudden trembling in my thumbs, which extended no further than my hands: this lasted about two or three seconds. After some seconds more, the same trembling was felt again. Sometimes it did not return in several minutes, and then came again, at very different intervals. Sometimes I felt the trembling both in my fingers and thumb. These tremors gave me the same sensation, as if a great number of very small electrical bottles were discharged through my hand very quickly one after the other. The fish occasioned the shock, or trembling, as well out of the water as in it. The shock lasted sometimes scarce a second; sometimes two or three seconds. Sometimes it was very weak; at other times so strong, that I was very near being obliged to quit my hold of the animal. The torpedo having given one shock, did not seem to lose the power of giving another of the same force soon again; for I observed

served several times, that the shocks, when they followed one another very fast, were stronger at last than in the beginning; and this was the same when the fish was under water as when kept out of it. The pressure of my fingers, more or less strong, did not seem to make any alteration in the powers of the torpedo. Applying a brass chain to the back of the fish, where I had put my thumb before, I found no sensation at all in my hand, though I repeated the experiment often, and applied the chain for a space of time in which I always perceived a stroke^(a). This was probably owing to the weakness of the fish in winter; or, perhaps, because I neglected to put my finger to its opposite side. Having insulated myself on an electrical stand, and keeping the torpedo in my hand, in the manner abovementioned, I gave not the least sign of being electrified, whether I received a stroke from the fish or not. The torpedo being suspended by a clean and dry silk ribbon, it attracted no light bodies, such as pith-balls, or others, put near it. A coated bottle applied to the fish, thus suspended, did not at all become charged. When the fish gave the shock in the dark, I heard no crackling noise, nor perceived any spark. When pinched with my nails, it did not give more or fewer strokes than when not pinched. But by folding his

(a) Dr. INGENHOUSZ means, that he felt no shock, though he saw the animal, by the contortion of its body, give one to the chain. At that time he did not seem to know, that though the shock would be communicated by a rod of any metal, it could not be so by a chain, or where there was the least interruption of continuity.

body, or bending his right side to his left side, I felt more frequent shocks. Dr. DRUMMOND made these experiments with me.

We dissected some of the torpedos, and found, if I remember well, four very large bundles of nerves, passing sidwards from the head into the two soft bodies, called *musculi falcati*, and distributed by dense ramifications through their whole substance. These nerves seem to terminate in round threads, which surround certain cylinders of a transparent gelatinous substance, which seems to constitute the material part of these singular bodies that appear to be the reservoirs of the electric power: these cylinders are parallel to each other, and have their direction from the under to the upper side of the fish. I did not observe whether these soft bodies changed in size when the torpedo gives a shock; but I suspect they do. I waited for a better opportunity to make a good many more experiments, and repeat, with more care, those already made. But though I have not been fortunate enough to find any other than what is above mentioned, I thought it my duty to inform you of what I have attempted, howsoever incomplete my researches have been. And if ever any further opportunity should offer, and in a better season, I shall not fail to make all the experiments I can think of, for illustrating so curious and interesting a subject. I am, &c.